



- A REVIEW

## PHARMACOGNOSTIC AND PHARMACOLOGICAL ASPECTS OF *CENTELLA ASIATICA*

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### ABSTRACT

Many herbal remedies have been employed in various medical systems for the treatment and management of different diseases. This plant *Centella asiatica* is a perennial herbaceous creeper, faintly aromatic and a valuable medicinal herb which has been used in different system of traditional medication for the treatment of diseases and ailments of human beings. It is reported to contain various biochemical compounds such as Alkaloids, Flavonoids, Glycosides, Terpenoids and Saponins etc. It has been reported as analgesic, anticonvulsant, antidiabetic, antidepressant, antifertility, antifilarial, antipsoriatic, anti-inflammatory, antioxidant, antileprotic, antimicrobial, antispasmodic, antitubercular, antitumor, antiulcer, anxiolytic, immunomodulatory, memory enhancing g, sedative, stimulant and wound healing activities. The present review attempts to encompass the up-to-date comprehensive literature analysis on *Centella asiatica* with respect to its phytochemistry, pharmacognostic characters and its various pharmacological activities.

**Key words:** *Centella asiatica*, Medicinal herb, Terpenoids, Memory enhancer, Wound healing, Antiulcer.

### INTRODUCTION

Herbal medicine is based on the premise that plants contain natural substances that can promote health and alleviate illness. There are many herbs, which are predominantly used to treat cardiovascular problems, liver disorders, central nervous system, digestive and metabolic disorders. Depending on their potential to produce significant therapeutic effect, they can be useful as drug or supplement in the treatment / management of various diseases.

*Centella asiatica* (Linn.) or *Hydrocotyle asiatica* (Linn.) is a prostrate, stoloniferous

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creeper which is a cosmopolitan member of the Apiaceae family and under the genus of *Centella*. Commonly known as Indian Pennywort, Marsh Pennywort, Brahmi, Gotu kola, Pohe Kula, Mandookaparni, Vallarai. It is distributed throughout tropical and subtropical regions of world such as India, Srilanka, China, Nepal, Indonesia, the Western South Sea islands, Madagascar, South Africa, South-East U.S, Mexico, Venezuela, Columbia and Eastern South America.

It is a perennial herb that has been valued for centuries in ayurvedic medicine for the treatment of leprosy, skin diseases, ulcers, asthma, body aches, bronchitis, elephantiasis, eczemas, anxiety, urethritis<sup>45</sup>, cataract, eye troubles, diarrhoea among children, wound healing<sup>12</sup> and for revitalizing the nerves and brain cells, hence primarily known as a "Brain food" or "Memory enhancer"<sup>9</sup> in India. Preparations of *C. asiatica* are used in traditional and alternative medicine due to the wide spectrum of pharmacological activities associated with the biologically active chemicals present in this plant.



*Centella asiatica*

### **Phytochemistry**

The scientific studies have proved that a variety of biologically active chemicals have been found in *Centella asiatica* which have immense medicinal potential. The following types of chemical constituents are reported in this plant :

#### **Triterpene saponins**

These are secondary plant metabolites and are synthesized *via* the isoprenoid pathway to produce a hydrophobic triterpenoid structure (aglycone) containing a hydrophilic sugar chain (glycone).

They are asiaticoside, centelloside, brahminoside madecassoside, thankuniside, isothankiniside etc.

### Sterols and lipid compounds

Stigmasterol, stigmasterone and stigmesterol- $\alpha$ -D-glucopyranoside<sup>14</sup>, campesterol, sitosterol. It also possesses glycerides of oleic, linoleic, linolenic, palmitic, stearic, lignoceric acids<sup>1</sup> and a green coloured essential oil.

**Flavonoids:** 3-glucosylquercetin, 3-glucosylkaemferol and 7-glucosylkaemferol have been isolated from the leaves<sup>3</sup>.

**Alkaloids:** Hydrocotylin<sup>1</sup> has been isolated from the dried plants.

**Amino acids:** Aspartic acid, lysine, serine, threonine, glycine, glutamic acid, histidine and  $\alpha$ -alanine, phenylalanine<sup>2</sup> have been reported from different plant parts.

**Others:** Vit. B, Vit. C<sup>22</sup>, Vit. G; carotenoids, polyacetylenes, sugars, oligosaccharide centellose, inorganic acids<sup>42</sup>, vellarin<sup>10</sup>, tannins, pectic acid, resin. The total ash contains chloride, sulphate, phosphate, iron, calcium, magnesium, sodium and potassium.

Chemical analysis of *C. asiatica* leaves have been reported the following values -

Moisture	87.2 g/100 g	Calcium	176 mg/100 g
Protein	1.7 g/100 g	Phosphorous	72 mg/100 g
Fat	0.7 g/100 g	Iron	12 mg/100 g
Carbohydrates	4.8 g/100 g	Vitamin C	42 mg/100 g
Crude fibre	3.4 g/100 g	Niacin	0.8 mg/100 g
Ash	2.3 g/100 g	Carotene	2,400 $\mu$ g/100 g
Energy	32 Kcal/100 g		

### Pharmacognostic studies

#### Organoleptic properties

Colour : Greyish green;

Odour : Characteristic;

Taste : Acrid, bitter, sweet;

Nature : Cool natured.

### Macroscopic characteristics

*Centella asiatica* (L.) is a prostrate, faintly aromatic, stoloniferous, perennial, creeper herb, attains up to an altitude of 1800 m. It flourishes extensively in shady, marshy, damp and wet places such as paddy fields, river banks forming a dense green carpet.

**Seeds** are solitary in each mericarp, pendulous embryo, laterally compressed.

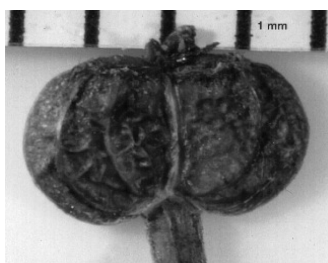
**Stem** is glabrous, striated emerging from the leaf-axils of a vertical rootstock, filiform, with long internodes and rooting at the nodes.

**Leaves** are cordate or hastate, 1-3 from each node of stems, long petioled, 2-6 cm long and 1.5-5 cm wide, orbicular-reniform, sheathing leaf base, crenate margins, glabrous on both sides, Leaf blades are dentate, crenate with thick radiate veins.

**Flowers** are small, sessile and dark pink in colour, arise as simple umbels of 3-6 flowers at the ends of slender peduncles arising from the axils of leaves and much shorter than petioles supported below by an involucre of 2 – boat shaped membranous persistent bracts. Each flower bears five stamens and two styles.

**Fruits** are clustered at joints, Carpels oblong, sub – cylindric curved and less in length much laterally compressed, readily separating into 2 indehiscent halves (mericarps) united by a very narrow plane of junction. Vittae are seen in the furrows of each mericarp.

The crop matures in three months and the whole plant, including the roots, is harvested manually.



**Fruit**



**Flowers**

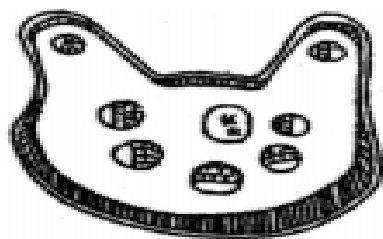


**Seeds**

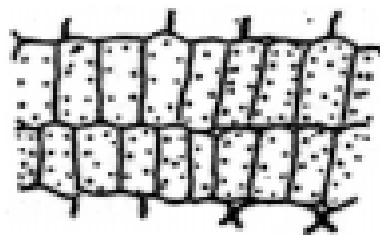
### Microscopic characteristics

Greyish green with stomata on both surfaces of the leaf, 30 by 28  $\mu\text{m}$ , mostly rubiaceous type. Palisade cells differentiated into 2 layers of cells, 45 by 25  $\mu\text{m}$ . Spongy

parenchyma of about three layers of cells with many intercellular spaces, some with rosette crystals of calcium oxalate. Hairs are absent; Midrib region shows 2 or 3 layers of parenchymatous cells without chloroplastids; Petiole shows epidermis with thickened inner walls; collenchyma of 2 or 3 layers of cells; a broad zone of parenchyma; 7 vascular bundles within parenchymatous zone, 2 in projecting arms and 5 forming the central strand; vessels 15–23µm in diameter. Some parenchymatous cells contain crystals of calcium oxalate. Fruits, epidermis of polygonal cells, trichomes similar to the leaves, sheets of elongated parquetry layer cells, bundles of narrow annular vessels and parenchymatous cells contain single large prisms of calcium oxalate.



T. S. of the petiole showing the arrangement of vascular bundles x 40



Double layer of the palisade cells x 440

### Pharmacological studies

Several pharmacological investigations for different biological activities of *Centella asiatica* in various *in vitro* and *in vivo* test models have been carried out based on the presence of chemical ingredients. A summary of the findings of some of these pharmacological studies is presented below -

Pharmacological activity	Type of plant extract	Laboratory animal used	References
Antioxidant	(1) Crude methanol extract	(1) Lymphoma bearing mice	31
	(2) Hydroalcoholic extract	(2) Albino mice & rats	35
Antidepressant	Total triterpenic fraction	Rat brain.	40
Antifertility	Crude extract & isothankunin side derivatives	Female mice	8
Antifilarial	Ethanol extracts of <i>C. asiatica</i> & <i>acacia auriculiformis</i>	Dogs infected with <i>dirofilaria immitis</i> .	17
Antiprotozoal	Alcoholic extract	<i>Entamoeba histolytica</i>	4

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<b>Pharmacological activity</b>	<b>Type of plant extract</b>	<b>Laboratory animal used</b>	<b>References</b>
Antispasmodic	Alcoholic extract	Rats	8
Antiviral	Crude water extracts	Anti herpes simplex virus	23
Antiinflammatory	Water extract & asiaticoside	Rats.	36
Anabolic effect	Total triterpenic fraction	Albino rats.	33
Anxiolytic effect	Hydroalcoholic extract	Male wistar rats & swiss mice	13
Antiulcerogenic	Fresh juice of plant	Rats	26
Cardioprotective	Alcoholic extract of whole plant	Rats	39
Cytotoxic & Antitumour	Crude extract	Tumour bearing mice	11
Radioprotective	(1) Plant extract & madecassol	(1) Rats	18
	(2) Essential oil of <i>C. asiatica</i>	(2) Swiss albino mice	6
	(3) Aqueous extract	(3) Male wistar rats	7
Neuroprotective	Asiatic acid derivatives	Primary culture of rat cortical neurons.	21
Anti colon cancer	Water extract	Rats	34
Anti skin cancer	Asiatic acid	Human melanoma cells	44
Memory enhancing	(1) Aqueous extract	(1) Lymphoma bearing mice	30
	(2) Fresh leaf juice	(2) Neonatal rats	43
Immunostimulant	Aqueous suspension	Rats	16
Tranquilizing effect	Alcoholic extract	Rats	5
Venous tone effects	(1) Total triterpenic fraction	(1) Human embryonic fibroblasts	25
	(2) <i>C. asiatica</i> extract	(2) Mice	28
Wound healing	(1) Triterpenoids	(1) Rats	8
	(2) Aqueous extract	(2) Rats	15
	(3) Asiaticoside.	(3) Guinea pigs	20
Increases general ability	<i>C. asiatica</i> tablets	Mentally retarded children	3

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Pharmacological activity	Type of plant extract	Laboratory animal used	References
Hepatoprotective	Whole plant powder	Rats	41
Anticonvulsant	(1) Hydroalcoholic extract	(1) Albino mice & rats	35
	(2) Ethanolic extract	(2) Mice	41
Gastric ulcer healing	Water extract & asiaticoside	Acetic acid induced rats.	36
Immunomodulatory	Methanol extract	Mice	37
Antibacterial	Ethanolic extract	Mice	38
Antimicrobial	(1) Triterpenes	(1) Human.	19
	(2) Essential oil of <i>C. asiatica</i>	(2) <i>E. coli</i> , <i>Aspergillus niger</i> , <i>Rhizopus oryzae</i> , <i>Fusarium solani</i> , <i>Candida albicans</i>	32
Antipsoriatic	Aqueous extract & triterpenoid saponins	<i>Invitro</i> keratinocytes	27
Sedative	(1) Ethanolic extract	(1) Mice	41
	(2) Hydroalcoholic extract	(2) Male wistar rats & swiss mice	13
Induce gene expression changes	Triterpenoids	Normal human fibroblast cell lines	29
Stimulation of extracellular matrix	Total triterpenic fraction	Swiss albino rats	24

## CONCLUSION

From the times immemorial, plants have been widely used as curative agents for variety of ailments. Concentrated leaves, fruits or seed extracts can be found in various herbal preparations are available in market today. It is believed that detailed information as presented in this review on its phytochemistry and various pharmacognostic and pharmacological properties of the plant and the constituents might provide incentive for proper evaluation of the use of this plant in medicine. Moreover, the mechanisms of action of few bioactive compounds have been identified so far. Hence, extensive research is required to find out the mechanisms of action of other compounds in crude extracts and to exploit their therapeutic potential to combat various diseases. Therefore, *Centella asiatica* play an important role in modern system of medicine as a multipurpose medicinal herb.

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